US008943857B2

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Kappler et al.

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(54) **CLOTHES WASHER DEMAND RESPONSE BY DUTY CYCLING THE HEATER AND/OR THE MECHANICAL ACTION**

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(73) Assignee: **General Electric Company**, Schenectady, NY (US)

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Related U.S. Application Data

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D06F 33/02 (2006.01)
D06F 39/00 (2006.01)

(52) **U.S. Cl.**
CPC ***D06F 39/006*** (2013.01); ***D06F 33/02*** (2013.01)
USPC **68/12.16**; 68/12.21

(58) **Field of Classification Search**
USPC 68/12.02, 12.12, 12.16, 12.21
See application file for complete search history.

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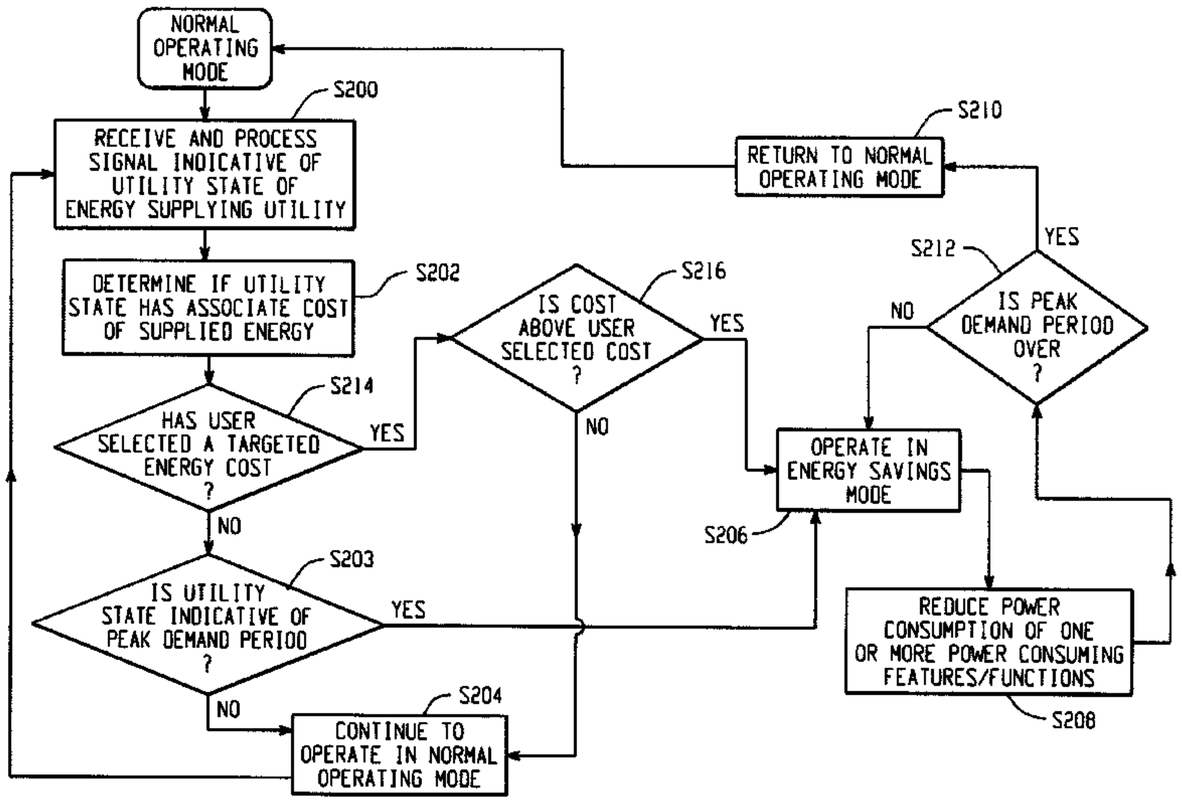
Primary Examiner — Joseph L Perrin
(74) *Attorney, Agent, or Firm* — GE Global Patent Operation; Marc A. Vivenzio

(57) **ABSTRACT**

A clothes washer is provided comprising one or more power consuming functions and a controller in signal communication with an associated utility. The controller can receive and process a signal from the associated utility indicative of current state of an associated utility. The controller operates the clothes washer in one of a plurality of operating modes, including at least a normal operating mode and an energy savings mode in response to the received signal. The controller is configured to change the power consuming functions by changing the duty cycling profile of the heater and/or mechanical action of the basket in the energy savings mode.

16 Claims, 7 Drawing Sheets



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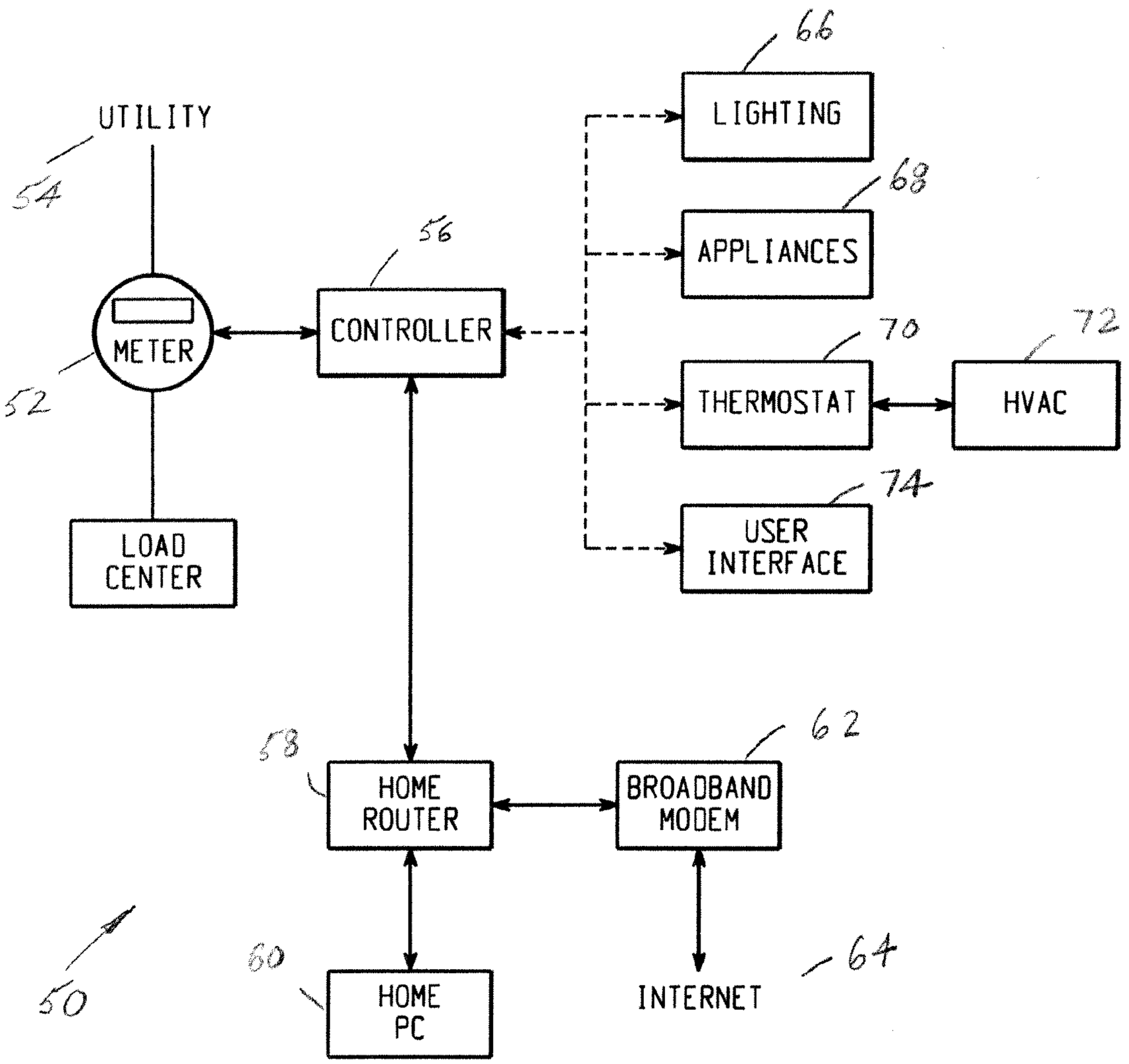
SYSTEM DIAGRAM
UTILITY
54
METER
52
LOAD CENTER
56
CONTROLLER
66
LIGHTING
68
APPLIANCES
70
THERMOSTAT
72
HVAC
74
USER INTERFACE
58
HOME ROUTER
62
BROADBAND MODEM
50
60
HOME PC
INTERNET
64

Fig. 1

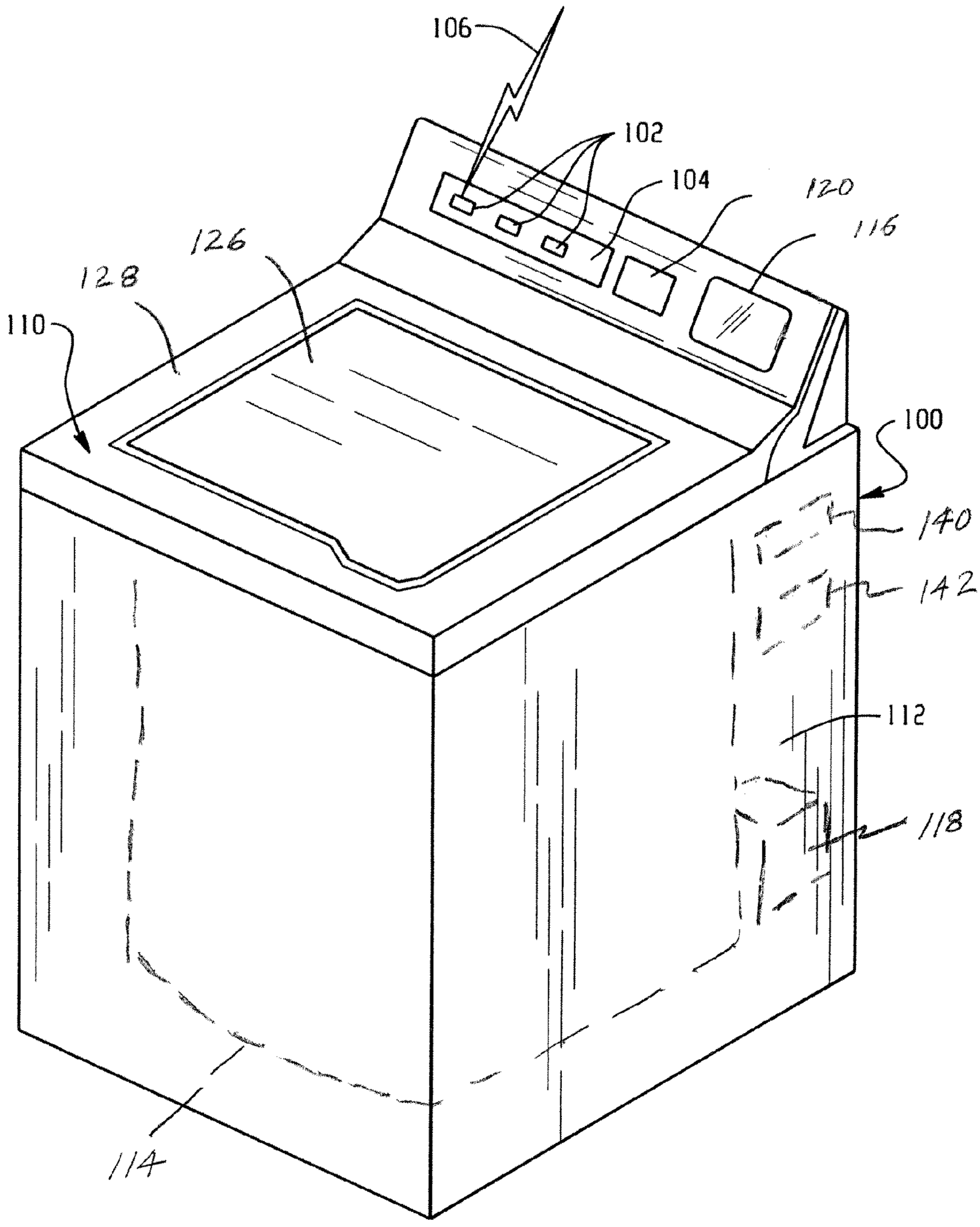

Fig. 2

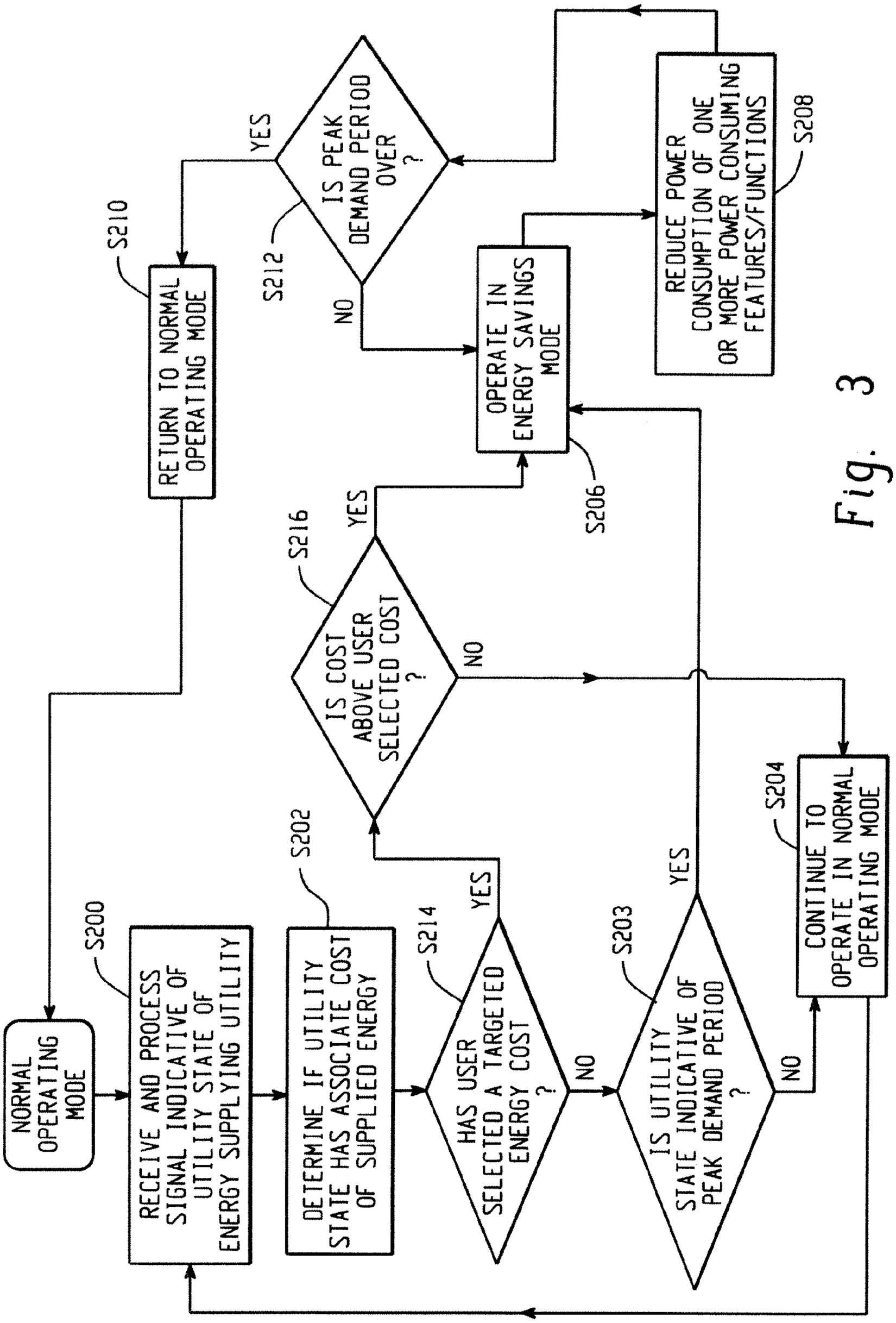
NORMAL OPERATING MODE
S200
RECEIVE AND PROCESS SIGNAL INDICATIVE OF UTILITY STATE OF ENERGY SUPPLYING UTILITY
S202
DETERMINE IF UTILITY STATE HAS ASSOCIATE COST OF SUPPLIED ENERGY
S214
HAS USER SELECTED A TARGETED ENERGY COST ?
YES
NO
S216
IS COST ABOVE USER SELECTED COST ?
YES
NO
S212
IS PEAK DEMAND PERIOD OVER ?
YES
NO
S210
RETURN TO NORMAL OPERATING MODE
S203
IS UTILITY STATE INDICATIVE OF PEAK DEMAND PERIOD ?
YES
NO
S204
CONTINUE TO OPERATE IN NORMAL OPERATING MODE
S206
OPERATE IN ENERGY SAVINGS MODE
S208
REDUCE POWER CONSUMPTION OF ONE OR MORE POWER CONSUMING FEATURES/FUNCTIONS

Fig. 3

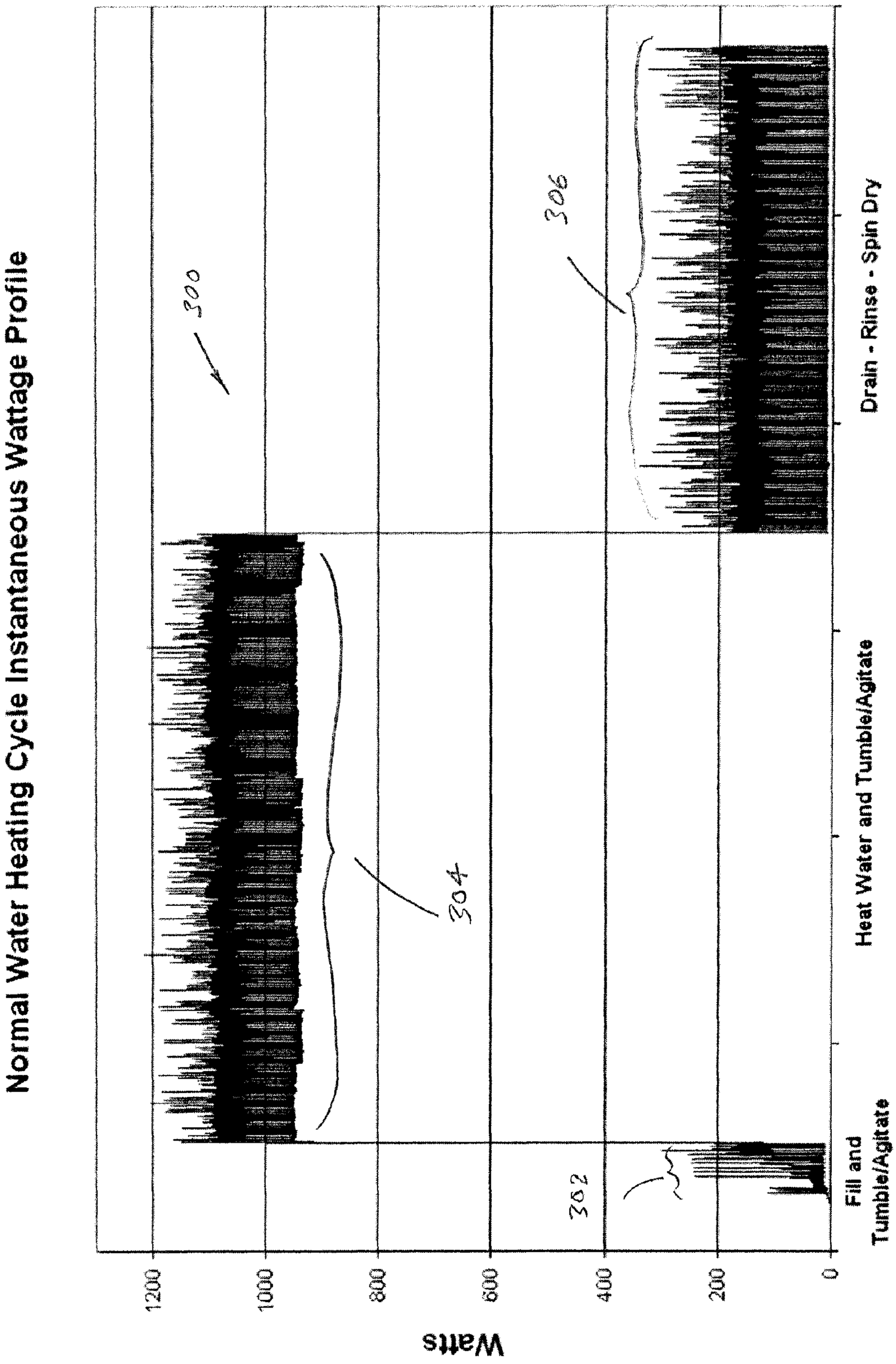
Normal Water Heating Cycle Instantaneous Wattage Profile
Watts
1200
1000
800
600
400
200
0
300
306
304
302
Heat Water and Tumble/Agitate
Drain - Rinse - Spin Dry
Fill and Tumble/Agitate
Cycle Time

FIG. 4

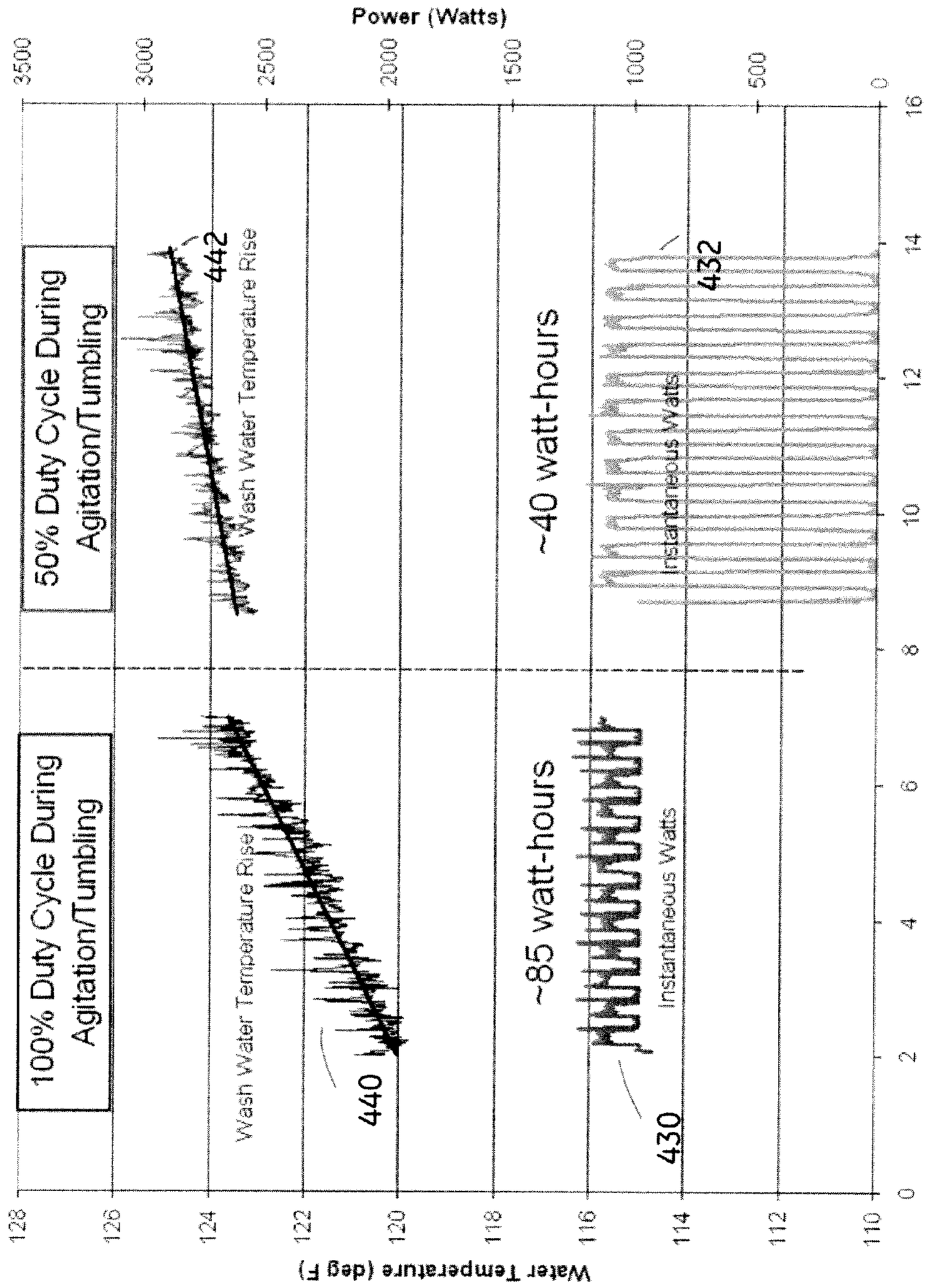
Power (Watts)
3500
3000
2500
2000
1500
1000
500
0
16
100% Duty Cycle During Agitation/Tumbling
50% Duty Cycle During Agitation/Tumbling
Wash Water Temperature Rise
442
440
~85 watt-hours
~40 watt-hours
Instantaneous Watts
432
430
Time (min)
Water Temperature (deg F)
128
126
124
122
120
118
116
114
112
110
0
2
4
6
8
10
12
14

Fig. 5

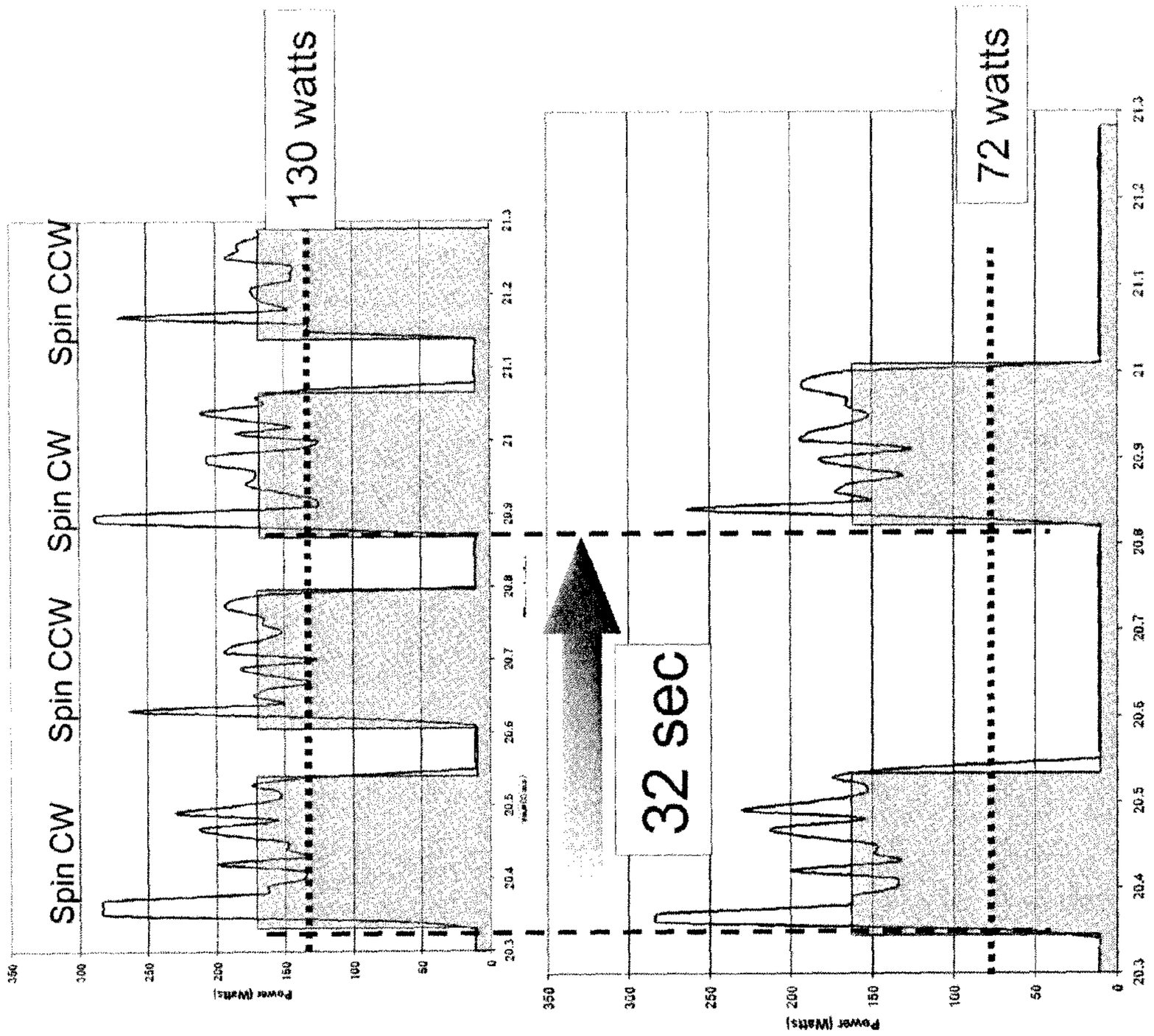
Spin CW
Spin CCW
Spin CW
Spin CCW
130 watts
72 watts
32 sec
Power (Watts)
Time (min)

FIG. 6

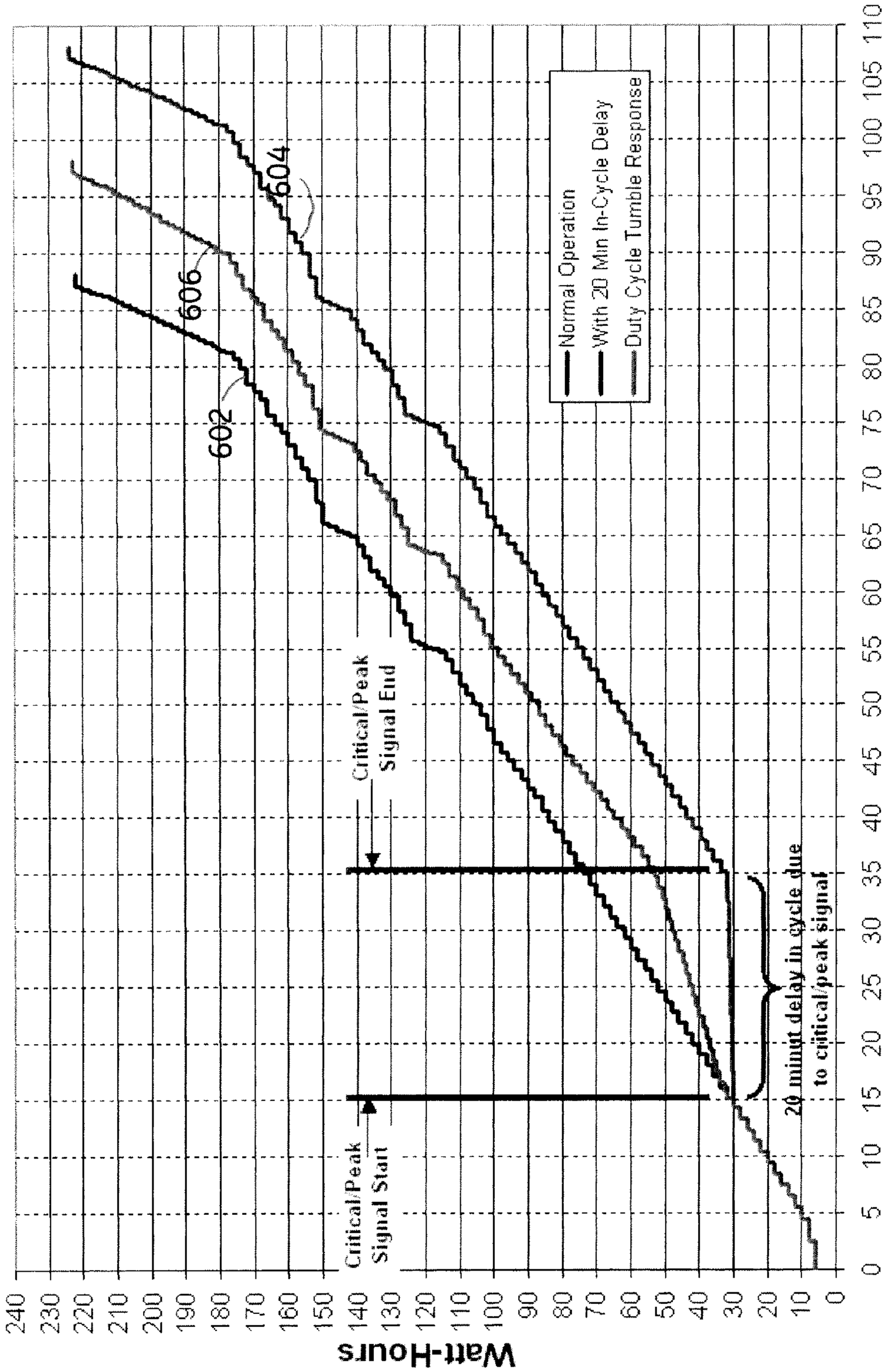
Watt-Hours
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Cycle Time (minutes)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
Normal Operation
With 20 Min In-Cycle Delay
Duty Cycle Tumble Response
602
604
606
Critical/Peak Signal Start
Critical/Peak Signal End
20 minute delay in cycle due to critical/peak signal

Fig. 7

CLOTHES WASHER DEMAND RESPONSE BY DUTY CYCLING THE HEATER AND/OR THE MECHANICAL ACTION

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part application and claims priority from U.S. patent application Ser. No. 12/559,751, filed 15 Sep. 2009, which application is expressly incorporated herein by reference in its entirety.

BACKGROUND OF THE DISCLOSURE

This disclosure relates to energy management, and more particularly to energy management of household consumer appliances. The present disclosure finds particular application to energy management of a clothes washer appliance, and is also referred to as a clothes washer demand response.

Currently, utilities charge a flat rate. Increasing costs of fuel prices and high energy use during certain parts of the day make it highly likely that utilities will begin to require customers to pay a higher rate during peak demand. Accordingly, a potential cost savings is available to the homeowner by managing energy use of various household appliances, particularly during the peak demand periods. As is taught in the cross-referenced applications, a controller is configured to receive and process a signal, typically from a utility, indicative of a current cost of supplied energy. The controller is configured to change the operation of an appliance from a normal mode (e.g., when the demand and cost of the energy is lowest) to an energy savings mode (which can be at various levels, e.g., medium, high, critical). Thus, various responses are desired in an effort to reduce energy consumption and the associated cost.

More particularly, the parent application noted above generally teaches adjusting operation schedule, an operation delay, an operation adjustment and a select deactivation on at least one or more power consuming features or functions to reduce power consumption of the clothes washer in the energy savings mode. For example, the operation delay may include a delay in start time, an extension of time to a delayed start, pausing an existing cycle, and delaying a restart. A need exists for providing alternative courses of operation in a peak demand state where a consumer's flexibility and convenience is maximized during peak pricing events.

SUMMARY OF THE DISCLOSURE

A clothes washer includes at least one power consuming feature, including a heater assembly and a drum for tumbling/agitating laundry articles. A controller receives and processes a signal indicative of the current costs of supplied energy, and operates the clothes washer in one of a plurality of operating modes, including at least a normal mode and an energy savings mode based on the received signal. The controller is configured to modify a duty cycle of at least one of a heater assembly and movement of the drum in response to a signal representing the energy savings mode.

The controller intermittently operates the heater assembly during the energy savings mode and/or a tumbling and/or agitation action of the drum is modified.

In the energy savings mode, the tumbling/agitation action is modified in one or more of the following ways: the angular speed of rotation of the action becomes slower, the time between direction reversal of the action becomes longer, the angular rotation of action becomes smaller, and the angular rotation of action becomes larger.

In another arrangement, in the energy savings mode the tumbling/agitation action is intermittent.

The controller operates the heater assembly at a lower average power for an extended period of time when compared to operating the heater assembly at a higher average power in the normal mode.

The duration of on and off operations of the heater is dependent on the signal received.

In the energy savings mode, the drum may be moved intermittently, or the duration of dwell between rotation or agitation direction changes may change depending on the signal received.

The present disclosure reduces the average power used by the clothes washer during peak pricing times, and/or reduces overall energy used by the clothes washer and dryer during peak pricing times.

The present arrangement saves on costs, and adds convenience and flexibility for the consumer to deal with pricing events.

Still another benefit resides in completing the cycle faster while still shedding electrical load without having to pause or delay the cycle entirely.

Selected ones of the solutions are easy to execute, i.e., requiring only software to change the clothes washer operation as a result of received signals.

Still other benefits and advantages of this disclosure will become more apparent upon reading and understanding the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic representation of an exemplary demand managed home including appliances such as a clothes washer.

FIG. **2** is a perspective view of a clothes washer.

FIG. **3** is a flowchart that generally illustrates the logic associated with a demand managed appliance.

FIG. **4** is a graphical representation of the instantaneous wattage profile for a typical washing machine cycle incorporating a heater.

FIG. **5** is a graphical illustration of duty cycling of a heater and its impact on water temperature and average power.

FIG. **6** illustrates energy savings associated with another form of duty cycling the mechanical action

FIG. **7** graphically represents one form of duty cycling the mechanical action response.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** shows a general system diagram **50** of a utility meter **52** that communicates with utility **54** and a controller **56** that receives and processes a signal from the meter. The occurrence of peak demand and demand limit data may be communicated by the utility and through the meter to the controller. The demand limit can be set by the homeowner or consumer in some instances. Additionally, the homeowner can choose to force various modes in the appliance control based on the rate that the utility is charging. The controller may interact with a home router **58**, home PC, broadband modem **62** or the internet **64**. Preferably, the controller **56** is configured to control various items in the home, such as the lighting **66**, one or more appliances **68** (including a clothes washer), the thermostat and HVAC **70**, **72**, respectively, and may include a user interface **74** that displays information for

the homeowner and allows the homeowner to program the controller or override selected functions if so desired. This system is generally shown and described in commonly owned U.S. patent application Ser. No. 12/559,703, filed Sep. 15, 2009.

An exemplary embodiment of a demand managed appliance **100** is clothes washer **110** schematically illustrated in FIG. **2**. The clothes washer **110** comprises at least one power consuming feature/function **102** and a controller **104** operatively associated with the power consuming feature/function. The controller **104** can include a micro computer on a printed circuit board which is programmed to selectively control the energization of the power consuming feature/function. The controller **104** is configured to receive and process a signal **106** indicative of a utility state, for example, availability and/or current cost of supplied energy. The energy signal may be generated by a utility provider, such as a power company, and can be transmitted via a power line, as a radio frequency signal, or by any other means for transmitting a signal when the utility provider desires to reduce demand for its resources. The cost can be indicative of the state of the demand for the utility's energy, for example a relatively high price or cost of supplied energy is typically associated with a peak demand state or period and a relative low price or cost is typically associated with an off-peak demand state or period.

The controller **104** can operate the clothes washer **110** in one of a plurality of operating modes, including a normal operating mode and an energy savings mode, in response to the received signal. Specifically, the clothes washer **110** can be operated in the normal mode in response to a signal indicating an off-peak demand state or period and can be operated in an energy savings mode in response to a signal indicating a peak demand state or period. As will be discussed in greater detail below, the controller **104** is configured to at least selectively adjust and/or disable the power consuming feature/function to reduce power consumption of the clothes washer **110** in the energy savings mode.

The clothes washer **110** generally includes an outer case or housing **112** and a control panel or user interface **116**. The clothes washer further includes a lid pivotally mounted in the top wall. Though not shown in the drawings, clothes washer **110** includes within outer case **112**, for example, a tub and/or wash basket **114** disposed for receiving clothes items to be washed, a drive system or motor **118** operatively connected to the controller and the basket **114** to tumble and/or agitate the wash load (also referred to herein as mechanical action) during wash and rinse cycles and spinning the basket during spin cycles, and a liquid distribution system comprising a water valve, for delivering water to the tub and basket and a pump for removing liquid from the tub, all of which may be of conventional design. Controller **104** is configured with a plurality of clothes washing algorithms preprogrammed in the memory to implement user selectable cycles for washing a variety of types and sizes of clothes loads. Each such cycle comprises a combination of pre-wash, wash, rinse, and spin sub-cycles. Each sub-cycle is a power consuming feature/function involving energization of a motor or other power consuming components. The amount of energy consumed by each cycle depends on the nature, number and duration of each of the sub-cycles comprising the cycle. The user interface **116** can include a display **120** and control buttons for enabling the user to make various operational selections. Instructions and selections are typically displayed on the display **120**. The clothes washer further includes a door or lid **126** mounted within a top wall **128**. Clothes washing algorithms can be preprogrammed in the memory accessed by the controller for many different types of cycles.

One response to a peak demand state is to delay operation, reschedule operation for a later start time, and/or alter one or more of selected functions/features in order to reduce energy demands. For example, clothes washers have the capacity to run at off-peak hours because demand is either not constant and/or the functions are such that immediate response is not necessary. However, a cost savings associated with reduced energy use during a peak demand period when energy costs are elevated must be evaluated with convenience for the consumer/homeowner. As one illustrative example, the clothes washer **110** that has been loaded during the daytime, i.e., typical peak demand period hours, can be programmed to delay operations for a later, albeit off-peak demand hours.

In order to reduce the peak energy consumed by a clothes washer, modifications and/or delays of individual clothes washer cycles can be adjusted in order to reduce the total and/or instantaneous energy consumed. Reducing total and/or instantaneous energy consumed also encompasses reducing the energy consumed at peak times and/or reducing the overall electricity demands during peak times and non-peak times.

In conjunction with the scheduling delays described above, or as separate operational changes, the following operation adjustments can be selected in order to reduce energy demands. The operation adjustments to be described hereinafter, can be implemented in conjunction with off-peak mode hours and/or can be implemented during on-peak mode hours. Associated with a clothes washer, the operational adjustments can include one or more of the following: a reduction in operating temperature (i.e. temperature set point adjustments) in one or more cycles, a disablement of one or more heaters in one or more cycles, reduction in power to one or more heaters, a switch from a selected cycle to a reduced power consumption cycle, a reduction in a duration of cycle time in one or more cycles, a disablement of one or more cycles, a skipping of one or more cycles, a reduction of water volume and/or water temperature in one or more cycles, and an adjustment to the wash additives (i.e., detergent, fabric softener, bleach, etc.) in one or more cycles. Illustratively, a switch from a selected cycle to a reduced power consumption cycle could include a change to the cycle definition when a command is received. For example, if a customer/user pushes "heavy duty wash" cycle, the selected cycle would then switch to a "regular" cycle, or the customer/user pushes "normal" cycle which would then switch to a "permanent press" cycle. As described, the switching is in response to lowering the energy demands from a selected cycle to a reduced power consumption cycle that meets a similar functional cycle.

With reference to FIG. **3**, a control method in accordance with the present disclosure comprises communicating with an associated utility and receiving and processing the signal indicative of cost of supplied energy (S**200**), determining a state for an associated energy supplying utility, such as a cost of supplying energy from the associated utility (S**202**), the utility state being indicative of at least a peak demand period or an off-peak demand period (S**203**). The method further includes operating the clothes washer **110** in a normal mode during the off-peak demand period (S**204**), operating the clothes washer **110** in an energy savings mode during the peak demand period (S**206**), selectively adjusting any number of one or more power consuming features/functions of the clothes washer to reduce power consumption of the appliance in the energy savings mode (S**208**), and returning to the normal mode (S**210**) after the peak demand period is over (S**212**). As further indicated in FIG. **3**, the clothes washer can also switch from operating in the normal operating mode to the energy savings mode (S**206**) when the user has selected a

targeted energy cost (S**214**) and the cost of supplied energy is above the user selected cost (S**216**).

It is to be appreciated that a selectable override option can be provided on the user interface **116** providing a user the ability to select which of the one or more power consuming features/functions are adjusted by the controller in the energy savings mode. The user can selectively override adjustments, whether time related or function related, to any of the power consuming functions. The operational adjustments, particularly an energy savings operation can be accompanied by a display on the panel which communicates activation of the energy savings mode. The energy savings mode display can include a display of "ECO", "Eco", "EP", "ER", "CP", "CPP", "DR", or "PP" or some other representation on the appliance display **120**. In cases with displays having additional characters available, messaging can be enhanced accordingly.

Another load management program offered by an energy supplier may use price tiers which the utility manages dynamically to reflect the total cost of energy delivery to its customers. These tiers provide the customer a relative indicator of the price of energy and in one exemplary embodiment are defined as being LOW (level 1), MEDIUM (level 2), HIGH (level 3), and CRITICAL (level 4). In the illustrative embodiments the appliance control response to the LOW and MEDIUM tiers is the same namely the appliance remains in the normal operating mode. Likewise the response to the HIGH and CRITICAL tiers is the same, namely operating the appliance in the energy saving mode. However, it will be appreciated that the controller could be configured to implement a unique operating mode for each tier which provides a desired balance between compromised performance and cost savings/energy savings. If the utility offers more than two rate/cost conditions, different combinations of energy saving control steps may be programmed to provide satisfactory cost savings/performance tradeoff. The operational and functional adjustments described above, and others, can be initiated and/or dependent upon the tiers. For example, the clothes washer **110** hot water selection can be prevented or 'blocked' from activating if the pricing tier is at level 3 or 4. The display **120** can include an audible and visual alert of pricing tier 3 and 4. Some communication line with the utility can be established including, but not limited to, the communication arrangements hereinbefore described. In addition, the display **120** can provide the actual cost of running the appliance in the selected mode of operation, as well as, maintain a running display of the present cost of energy. If the utility offers more than two rate/cost conditions, different combinations of energy saving control steps may be programmed to provide satisfactory cost savings/performance tradeoff.

Turning next to FIGS. **4** and **5**, some clothes washers are provided with a sanitization or sanitizing cycle in which a heater elevates the water temperature in the clothes washer above 140° F., and preferably to approximately 140°-150° F., for an extended time period, e.g., on the order of 30-60 minutes. This is represented in FIG. **4**, where the instantaneous wattage profile **300** of a wash cycle that includes a sanitizing cycle (also generally referred to as water heating) is illustrated. After a fill and tumble/agitate portion **302** of the wash cycle, the water is then heated and then further tumbled/agitated in the sanitizing portion **304** of the wash cycle where energy use in the exemplary embodiment is on the order of 900-1,200 watts. Once the water heating portion **304** of the wash cycle is complete, a remainder **306** of the wash cycle, i.e., drain, rinse, and spin dry, is completed.

As shown in FIG. **4**, the most energy intensive portion of the wash cycle is associated with the sterilization or sanitization portion **304**. One response in a peak pricing period is to disable the water heating cycle, i.e., not allow the sanitizing portion of the wash cycle to be activated or alternatively delay the wash cycle, although such delay may be on the order of many hours. Although both of these options provide potential cost savings to the user/homeowner, these options are generally viewed as a potential inconvenience. On the other hand, there is an option of allowing the clothes washer to operate in the normal mode, i.e., run the water heating portion of the wash cycle during the peak demand period. As will be appreciated from FIG. **4**, however, this has the potential to result in a cost increase for the consumer during a peak demand.

A solution to simultaneously satisfy a desire to save energy and reduce costs while also limiting inconvenience to the homeowner is to intermittently operate or change the duty cycle of the heater **140**. That is, the heater operation can be changed by optimizing how frequently the heater is turned on and off during critical or peak demand times in order to reduce the average power usage. Although this would result in a longer cycle, it would help to alleviate the grid and possibly reduce total energy usage during the cycle due to residual unpowered heating effects. Depending on the demand response, e.g., critical, high, medium, etc., multiple duty cycles may be provided to address these various responses. The duty cycle response can be specifically tuned based on the data received from the utility for various critical pricing events. The clothes washer can automatically modify the heating profile to a different duty cycle to reduce average power usage and yet still complete the wash cycle. Again, although the cycle will take longer to maintain the performance attributes of the cycle, this arrangement would allow the cycle to be completed without as much delay as if the cycle were simply paused or deferred until a more economical pricing event occurred. Not only does the consumer or homeowner save money, but this arrangement offers convenience and flexibility to deal with pricing events as communicated by the utility on a real time basis. The cycle can be completed faster while still shedding electrical load and without having to pause or delay the cycle entirely.

As illustrated in FIG. **5**, continuously operating the heater **140** (i.e., operating at 100%) results in expending approximately 85 watt-hours over a typical 5 minute period during a washing machine cycle incorporating a heater. On the contrary, duty cycling the heater to operate 50% of the time by intermittently turning the heater on and off results in expending about 40 watt-hours during an equivalent 5-minute period. Wash water temperature increases in a generally linear fashion as shown in plot **440** with regard to constant heater operation while the wash water temperature plot **442** relating to intermittent operation of the heater is also generally linear but at a reduced slope (i.e., more gradual increase over time). This corresponds to the extension of the total cycle length when operating the heater at lower duty cycles. Again, these are simply representative temperature plots and should not otherwise be deemed limiting to the present disclosure.

Duty cycling the heater also has an overall energy benefit as a result of the heater being above the water temperature for a few seconds even when turned off and the heater is still increasing the temperature of the water. It is also contemplated that the heater may cycle between a high state and low state (a reduced wattage level) during the duty cycling, i.e., the heater may not be required to turn "OFF".

In addition, if the DSM signal reduces to a non-high or a non-peak level during the extended heating cycle, the controller **104** can be configured to allow the clothes washer to return to the normal operation mode or could continue with the energy savings mode of operation until the wash cycle is

complete. Another advantage provided by the duty cycling option is that the controller **104** can be easily modified by updating the software on the control board of the clothes washer to achieve these energy benefits without altering the physical components of the clothes washer.

As shown in FIG. **6**, another type of demand response is exemplified. More particularly, the time period between the mechanical action can be altered in the energy savings mode for a significant reduction in average power use (e.g. 130 watts in the normal mode in the upper plot of FIG. **6** and only 72 watts of power used in the lower plot) by increasing the time period between direction reversals in the mechanical action. Note that mechanical action represents movement of a typical basket, drum, agitator, impeller or other similar device intended to move the clothes load inside of a washing machine during operation. For example, in the normal profile of FIG. **6**, the spin occurs for about 12 seconds and then the basket coasts for approximately 4 seconds before the next spin operation. In the energy savings mode where the exemplary profile shows a 50% duty cycle, the spin still occurs for about 12 seconds while the time period for coast action is extended to approximately 20 seconds. Over a twenty minute time frame, a reduction of nearly 20 watt-hours can be achieved (referring to FIG. **6**). Once again, the referenced numerical values are exemplary only and one skilled in the art will understand that individual energy savings and average power savings may vary depending on whether one or more of these features are used in combination. Total cost savings will likewise vary depending on the associated energy costs charged by the utility and selections by the homeowner whether to adopt one or more of the demand responses for the clothes washer.

FIG. **7** gives a full cycle view regarding the effects of duty cycling the mechanical action of a washing machine. A normal mode of operation is represented by plot **602** while a twenty minute in-cycle delay response in an energy savings mode is shown by plot **604**. Still another demand response to a peak demand period is to duty cycle the mechanical action, i.e., the tumble and/or agitation of the clothes, in an energy savings mode as represented by plot **606**. As is evident, the overall cycle time is slightly increased, yet is completed faster than a simple delay (**604**) and results in no increase in total energy used. Further, time shifting, delaying, or increasing the cycle time enhances the possibility that the peak demand period will expire and operation can return to the normal mode since less expensive energy will become available. The duty cycling of the motor that controls the mechanical action of the basket can be used as a potential demand response or used in conjunction with one or more of the above noted responses (just as any one of the noted responses can be used selectively with one or more of the other responses). Thus, the mechanical action can be modified by, for example, reducing the angular speed of rotation of the mechanical action, increasing the time between direction reversal of the mechanical action, reducing the angular rotation of the mechanical action, increasing the angular rotation of the mechanical action, and/or duty cycling the mechanical action. It is also contemplated that the amount of change in the mechanical action can be made dependent on the level of the signal received.

The disclosure has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations.

What is claimed is:

1. A clothes washer comprising:

at least two power consuming features including a heater assembly configured to heat water used by the clothes washer and a drive system configured to effectuate mechanical action on a device intended to move a load of clothes disposed inside the clothes washer;

a controller configured to receive and process a signal indicative of the cost of supplied energy and, based on the received signal, is further configured to operate the clothes washer in one of a plurality of operating modes including at least a normal mode where the drive system is configured to operate over a first total cycle time and consume a first amount of energy, and an energy savings mode where drive system is configured to duty cycle so as to operate over a second total cycle time greater than the first total cycle time and consume a second amount of energy less than or equal to the first amount of energy;

wherein when the cost of supplied energy is above a user selected targeted energy cost, the controller is configured to operate the clothes washer in the energy savings mode.

2. The clothes washer of claim **1** wherein in the energy savings mode operation of the drive system is further modified by at least one of reducing an angular speed of rotation of a mechanical action effectuated by the drive system, altering a time between direction reversal of a mechanical action effectuated by the drive system, and altering an angular rotation of a mechanical action effectuated by the drive system.

3. The clothes washer of claim **2** wherein in the energy savings mode the amount of change of the at least one mechanical action effectuated by the drive system is dependent on the level of signal received.

4. The clothes washer of claim **1** wherein in the energy savings mode drive system is configured to operate intermittently to generate intermittent mechanical actions with equal time delays or pauses between subsequent mechanical actions.

5. The clothes washer of claim **1** wherein in the energy savings mode the heater assembly is duty cycled to reduce the average power used by the heater assembly.

6. The clothes washer of claim **5** wherein the heater assembly is intermittently turned on and off so that subsequent on periods and off period are equal.

7. The clothes washer of claim **5** wherein in the energy savings mode an amount of change of an average power of the heater assembly is dependent on the level or duration of the signal received.

8. The clothes washer of claim **1** wherein in the heater assembly is operatively associated with a water heating cycle and the drive system is operatively associated with at least one of a wash cycle, a rinse cycle and a spin cycle.

9. A clothes washer comprising:

a housing;

a tub or basket dimensioned to receive laundry items therein;

a drive system received in the housing configured to effectuate mechanical action to the tub or basket;

an inlet adapted to selectively provide water to the tub or basket;

an outlet adapted to selectively drain water from the tub or basket;

a heater assembly for heating water supplied through the inlet; and

a controller operatively associated with the tub or basket, inlet, outlet, and heater assembly for controlling operation of the clothes washer through various operating

cycles, the controller configured to receive and process a signal indicative of the cost of supplied energy and, based on the received signal, is further configured to operate the clothes washer in one of a plurality of operating modes including at least a normal mode where the drive system is configured to operate over a first total cycle time and consume a first amount of energy and an energy savings mode where the drive system is configured to duty cycle so as to operate over a second total cycle time greater than the first total cycle time and consume a second amount of energy less than or equal to the first amount of energy;

wherein when the cost of supplied energy is above a user selected targeted energy cost, the controller is configured to operate the clothes washer in the energy savings mode.

10. The clothes washer of claim **9** wherein in the energy savings mode operation of the drive system is further modified by at least one of reducing an angular speed of rotation of a mechanical action effectuated by the drive system, altering a time between direction reversal of a mechanical action effectuated by the drive system, and altering an angular rotation of a mechanical action effectuated by the drive system.

11. The clothes washer of claim **10** wherein in the energy savings mode the amount of change of the at least one mechanical action effectuated by the drive system is dependent on the level of signal received.

12. The clothes washer of claim **9** wherein in the energy savings mode the drive system is configured to operate intermittently to generate intermittent mechanical actions with equal time delays or pauses between subsequent mechanical actions.

13. The clothes washer of claim **9** wherein in the energy savings mode the heater assembly is duty cycled to reduce the average power used by the heater assembly.

14. The clothes washer of claim **13** wherein the heater assembly is intermittently turned on and off so that subsequent on periods and off period are equal.

15. The clothes washer of claim **13** wherein in the energy savings mode an amount of change of an average power of the heater assembly is dependent on the level or duration of the signal received.

16. The clothes washer of claim **9** wherein in the heater assembly is operatively associated with a water heating cycle and the drive system is operatively associated with at least one of a wash cycle, a rinse cycle and a spin cycle.

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